

The Pennsylvania Local Roads Program

Preventive Maintenance for Bridges*Diane Purdy, Penn State*

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Bridges, including those on local roads, are important components of the roadway system. Despite their importance, they are generally the most neglected elements of the infrastructure. The result is that bridges are deteriorating faster than would be the case if they were being maintained and repaired, hastening them to the point where they need costly rehabilitation or replacement.



Deteriorated steel rocker bearing from
www.dot.state.oh.us/preventivemaintenance/bearings/bearings.htm.

WHAT IS PREVENTIVE MAINTENANCE?

Preventive maintenance may be a new concept to many bridge owners, so it's understandable that some confusion exists as to what is considered preventive maintenance and what is corrective maintenance. Preventive maintenance can be defined as a planned strategy of cost-effective treatments to a structure to preserve it in its present condition and to retard future deterioration. The objective of preventive maintenance is to extend the service life of a bridge before bridge conditions deteriorate to a level requiring corrective maintenance. Corrective maintenance involves activities or operations applied to fix bridge deficiencies. Preventive maintenance is applying the right treatment, to the right structure, at the right time. Preventive and corrective maintenance are both desirable in a comprehensive bridge preservation program, but emphasis should be placed on preventive maintenance, since costs associated with corrective maintenance can be significant. This technical information sheet will highlight preventive maintenance activities.

IMPORTANCE OF PREVENTIVE MAINTENANCE

When we make an investment in a car, it makes sense to extend the life of this asset and ensure trouble-free driving throughout that life by performing preventive maintenance tasks. These include changing the oil regularly and touching up places where the paint has chipped so the exposed metal does not rust. Similarly, we perform preventive maintenance tasks on our homes to maintain the property value and to minimize major repair work and expense. We clean the gutters and downspouts and check the roof for loose shingles. The same care should be applied to our bridges to preserve these significant investments in our transportation system.

If preventive maintenance is such a great idea, why don't we practice it on every bridge in our jurisdiction? Perhaps it's because "we

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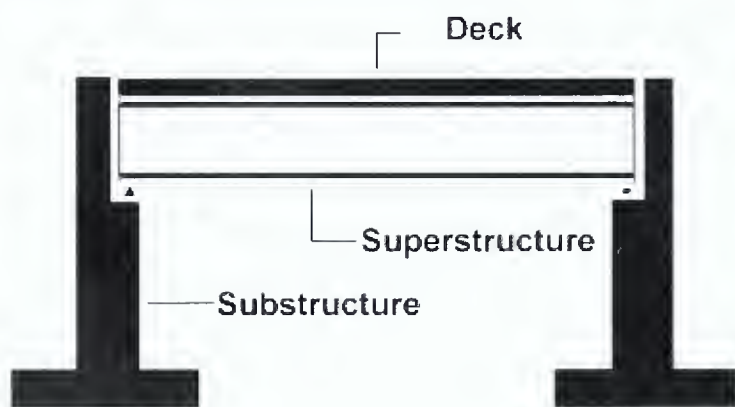
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just don't have the money" or "we just don't have the time or staff." This may be true, but regardless of the reason, you inevitably will have to find the money, make the time, and provide the resources to deal with the consequences of not having a preventive maintenance program in place. Many transportation agencies are painfully arriving at this conclusion as they attempt to stretch available funds to keep rapidly deteriorating structures in service. A bridge in good condition costs less to maintain. Studies have shown that as the condition of a bridge deteriorates, the cost of necessary repairs rises at a rapidly increasing rate. If maintenance is deferred for a period of time, the cost to restore a bridge to adequate or good condition is significantly greater than to regularly maintain it in good condition.

BRIDGE COMPONENTS

Before we discuss preventive maintenance, let's review basic bridge components.



Deck: The portion of the bridge that provides a surface for vehicular or pedestrian traffic.

Superstructure: The portion of a bridge above and including the bearing device that supports vehicular or pedestrian traffic and transfers the applied loads to the bridge substructure. The major components include the deck, the beams or girders, and the parapets, railings, sidewalks, curbs, drainage features, joints and bearings.

Substructure: The portion of a bridge below the bearing device, built to support the superstructure and transmit loads to the foundation. The main components are abutments, piers, bents and footings.

Materials: Most bridge decks are constructed as reinforced concrete slabs, but timber and open grid steel decks may be used in rural areas and over waterways. The main superstructure elements are generally made of reinforced concrete, steel or timber. The substructure members are commonly made of reinforced concrete and masonry, although some bridges have been constructed with timber and steel.

TYPES OF MAINTENANCE

Maintenance can be classified into two types: preventive and demand. Scheduled preventive maintenance includes activities performed on a regular or cyclic basis, such as:

- Cleaning decks, drainage systems and expansion joints.
- Cleaning bridge seats, pedestals, caps and salt splash zones^{1,2}.
- Cleaning and lubricating expansion bearings.
- Sealing concrete decks or substructure elements.

Demand maintenance includes activities performed as needed or as identified through the inspection process, such as:

- Rescaling expansion joints.
- Painting steel members.
- Removing debris from stream channels.
- Replacing wearing surfaces on decks.
- Extending or enlarging deck drains.

Preventive maintenance activities, bridge areas to which they apply, brief descriptions of them, their purposes, and how often to conduct them are presented in the table on page 3.

BENEFITS

The anticipated benefits of a preventive maintenance program for bridges are:

- Higher user satisfaction.

- Better informed bridge maintenance decisions.
- Improved maintenance strategies and techniques.
- Improved bridge conditions.
- Cost savings.
- Increased safety.

PENNDOT'S APPROACH

Perform the *right* treatment at the *right* time on

the *right* bridge. This philosophy is endorsed by PennDOT and showcased in a video, *Pennsylvania Bridges: Maintaining the Past – Preserving the Future*. “Spending a relatively small amount of money today will save us large amounts of money tomorrow,” said Gary Hoffman, former chief engineer at PennDOT and now deputy secretary for highway administration, in an article about the video in a 2002 Federal Highway Administration publication (*see sources page 4*). **(LTAP has copies of the video on CD. Call 1-800-FOR-LTAP to request one.)**

Scheduled preventive maintenance.

Activity	Work Area	Description	Purpose	Frequency
Clean bridge (superstructure)	Decks	Remove salt, dirt and debris Sweep and flush with water	Prevent concrete deterioration Prevent corrosion of reinforcement steel	Once a year or Additional cleaning as needed
	Joints	Remove dirt and debris from joint openings	Allow movement of the superstructure Protect area under the joint	Once a year or Additional cleaning as needed
	Scuppers Downspouting	Remove salt, dirt and debris Flush with water, air blast, or use mechanical devices	Keep drainage system clear and run-off flowing freely	Once a year or Additional cleaning as needed
	Steel members	Remove debris and salt residue Scrape, brush, or use mechanical devices Flush with water	Reduce corrosion of steel members	Once a year or Additional cleaning as needed
	Bearings	Remove salt, dirt, and debris Scrape, brush, or use mechanical devices Flush with water	Ensure bearings function properly to transfer loads Allow movement of superstructure	Once a year or Additional cleaning as needed
Clean bridge (substructure)	Bridge seats Pedestals Salt splash zones	Remove salt, dirt and debris Pressure wash, hand wash or use mechanical methods	Prevent concrete deterioration Prevent corrosion of reinforcement steel	Once a year or Additional cleaning as needed
Seal concrete deck	Deck Curbs Sidewalks Parapet	Apply sealant to superstructure elements Seal new decks prior to bridge opening	Protect the deck from water and chlorides	Every five years or As indicated by inspection
Lubricate bearings	Bearings such as rocker, roller and sliding	Jack structure Clean, lubricate and paint bearings	Ensure bearings function properly to transfer loads Allow movement of the superstructure	Every five years or As indicated by inspection
Seal concrete substructures	Abutments Piers	Apply sealant to substructure elements	Protect substructure elements from water and chlorides	Every five years or As indicated by inspection

PennDOT maintains the third largest number of state-owned bridges of any state in the nation, spending \$300 million on bridge projects each year. To keep costs down and improve safety, PennDOT has found that it is vital to perform frequent inspections and maintain a reliable preventive maintenance program. PennDOT inspects all of the agency's bridges every two years and stores the bridge data in a management system that allows users to prioritize the maintenance and rehabilitation needs of the bridge infrastructure. To further assist the maintenance staff, PennDOT has developed the following publications:

- *Procedures and Standards for Bridge Maintenance*, Publication 55. 2002.
- *Maintenance Manual*, Bureau of Maintenance and Operations, Publication 23. 2004.

Consulting these publications will greatly aid the establishment of a preventive maintenance program for municipal bridges. *Procedures and Standards for Bridge Maintenance* breaks maintenance activities into specific, detailed tasks. The chapter on Bridge Maintenance in the *Maintenance Manual* provides further background on bridge components and the importance of preventive maintenance. The manuals can be viewed at the PennDOT Web site, www.dot.state.pa.us, under Bureau of Office Services, then Publications. Copies can be ordered as well. Call the PennDOT Sales Store at 717-787-6746.

CLOSING

To achieve a cost-effective preventive maintenance program, it is necessary to apply the right treatment, to the right structure, at the right time. Because municipalities are responsible for the maintenance of many bridges in various stages of deterioration, procedures must be developed to identify the bridges that would benefit most from preventive maintenance (the right bridge), select the most beneficial treatment (the right treatment), and apply the treatment in a timely manner (the right time).

NOTES

¹The top portions of abutments and piers consist of bridge seats, pedestals and caps upon which the superstructure rests.

² Bridge elements that are affected by salt spray from passing vehicles are located in splash zones.

SOURCES

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Leaking deck joint (from www.fhwa.dot.gov/bridge/images/frp012.jpg).

Call 1-800-FOR-LTAP for more information on bridge maintenance.